

Tackling food marketing to children in a digital world: trans-disciplinary perspectives

Children's rights, evidence of impact, methodological challenges,
regulatory options and policy implications for the WHO European Region



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Abstract

This publication provides up-to-date information on the marketing of foods and non-alcoholic beverages to children and the changes that have occurred in recent years, focusing in particular on the major shift to digital marketing. It examines trends in media use among children, marketing methods in the new digital media landscape and children's engagement with such marketing. It also considers the impact on children and their ability to counter marketing as well as the implications for children's digital privacy. Finally the report discusses the policy implications and some of the recent policy action by WHO European Member States.

Keywords

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Glossary

Advergame	A digital game that features branded content and is used to advertise a brand
Advertising	“One type of marketing activity” (1)
Child	People under 18 years of age, in line with the United Nations Convention on the Rights of the Child (2) and the WHO Commission on Ending Childhood Obesity (3)
Influencer	An Internet personality, usually with a personal channel (on e.g. YouTube) with a high subscriber base, whose opinions and recommendations influence their subscribers
Marketing	An activity in which an organization engages to facilitate exchange between itself and its customers (1)
Online behavioural advertising	Advertising delivered according to an individual’s demographics and online behaviour and preferences
Vlogger	A video blogger on a digital platform, such as YouTube

Abbreviations

COPPA	Children’s Online Privacy Protection Act (USA)
FTC	Federal Trade Commission (USA)
GDPR	General Data Protection Regulation (European Union)
HFSS	high in saturated fats, salt and/or free sugars

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Summary

There is unequivocal evidence that childhood obesity is influenced by marketing of foods and non-alcoholic beverages high in saturated fat, salt and/or free sugars (HFSS), and a core recommendation of the WHO Commission on Ending Childhood Obesity (3) is to reduce children's exposure to all such marketing. As a result, WHO has called on Member States to introduce restrictions on marketing of HFSS to children, covering all media, including digital, and to close any regulatory loopholes.

Children across Europe access digital media avidly, predominantly on mobile devices, generally favouring social media and video viewing sites for mixed audiences. Brands and marketers report that digital marketing (including for HFSS foods) amplifies advertising in traditional media, achieving greater ad attention and recall, greater brand awareness and more positive brand attitudes, greater intent to purchase and higher product sales. Digital platforms collect extensive personal data from Internet users to deliver behavioural advertising, specifying audiences with precision and targeting the most vulnerable, and there is little effective regulation to protect children from this practice. The aim of digital HFSS marketing is to engage children in emotional, entertaining experiences and to encourage them to share these experiences with their friends. The algorithms of the major platforms give preference to less overt, longer-viewed advertisements (ads), thus bypassing any media literacy children might have and amplifying the power of practices in traditional media.

The food, marketing and digital industries have access to extremely fine-grained analyses of children's behaviour and exposure to HFSS, yet external researchers are excluded from these privately held insights, which increases the power imbalances between industry and public health. There is convincing evidence that HFSS marketing in traditional media has detrimental effects on children's eating and eating-related behaviour, and early studies suggest that HFSS marketing in digital media has similar effects. Major methodological challenges remain for researchers, however, and much new trans-disciplinary work is required to identify the full extent, nature and impact of digital HFSS marketing on children.

Existing regulations are markedly insufficient to address the challenges in this field. Regulations frequently apply to pre-digital media only, apply only to younger children and not to adolescents (failing to allow for adolescents' vulnerability to HFSS advertising) or do not address the complex challenges of supra-national regulation of global media.

Both a rights-based approach to childhood obesity and regulation of digital marketing must take into account the rights of children to participation and protection under the United Nations Convention on the Rights of the Child (2). Thus, children have the right to participate in digital media; and, when they are participating, they have the right to protection of their health and privacy and not to be economically exploited. States should support parents in upholding these rights. Children's participation in digital media should not be predicated on receiving digital HFSS advertising, nor should it be predicated on "devolving" consent to parents. Instead, States and supra-national actors should devise ways to ensure that children participate in the digital world without being targeted by marketers with immersive, engaging, entertaining marketing that has been demonstrated to be injurious to their health.

To achieve this goal, the report identifies eight key components for effective policies. States should (i) acknowledge their duty to protect children from HFSS digital marketing with statutory regulation and (ii) extend any existing offline protection online. Furthermore, rather than leaving commercial interests to define the parameters of marketing to children, as is frequently the case, States should (iii) define "marketing directed at children" as well as (iv) the legal age at which marketing to children could be permitted. The report also notes that States can (v) draw on existing legislation, regulation and regulatory agencies in framing protection for children and proposes that States (vi) draw on existing practices for regulating Internet content and compel private Internet platforms to remove marketing of HFSS foods. Finally, to ensure that strategies to regulate marketing in the digital landscape are effective, the report notes that international legislation now recognizes the need for (vii) serious sanctions, including monetary penalties, and (viii) international cross-border strategies.

Background

The prevention and control of noncommunicable diseases is a core priority of WHO and its Member States. These diseases are currently the leading cause of death and disability in the WHO European Region and are responsible for more deaths worldwide than all other causes combined, and it is predicted that, by 2030, 52 million deaths per year will be attributable to them (4). Driven by lifestyle risks such as an unhealthy diet, noncommunicable diseases are increasingly occurring in younger people, due to e.g. overweight and obesity, raised blood pressure and blood glucose, and abnormal blood lipids (5). In some countries, children and adolescents account for 20–50% of cases of new-onset diabetes (6), and young people increasingly present with risk factors for cardiovascular diseases, including pre-hypertension (7).

In Europe, overweight and obesity are highly prevalent among children and adolescents, particularly in southern countries. The WHO European Childhood Obesity Surveillance Initiative has shown that, in some countries, almost 50% of eight-year-old boys are overweight and more than 25% are obese (8). Such alarming high rates of childhood obesity, increasingly seen worldwide in high- and low-income countries alike, not only pose a health risk but also breach the right to health, as stated in the United Nations International Covenant on Economic, Social and Cultural Rights (9), and children's rights to the development and enjoyment of the highest attainable standards of health in the United Nations Convention on the Rights of the Child (2). As States are obliged not only to respect and protect but also to fulfil human rights, they are obliged to act on this global risk to health.

WHO set global targets to halt the rise in obesity in the Global Action Plan on the Prevention and Control of Noncommunicable Diseases (10) and the Comprehensive Implementation Plan on Maternal, Infant and Young Child Nutrition (11). Subsequently, the report of the WHO Commission on Ending Childhood Obesity (ECHO Commission) (3), based on consultations with 118 WHO Member States, made comprehensive recommendations to reduce children's and adolescents' intake of foods and non-alcoholic beverages high in saturated fats, salt and/or free sugars (hereafter "HFSS foods") to limit excess weight gain. A core recommendation is to reduce children's and adolescents' exposure to all forms of marketing for such foods, including in digital media, in view of "unequivocal evidence that the marketing of unhealthy foods and sugar-sweetened beverages is related to childhood obesity". A recent review for the United Kingdom's Committee of Advertising Practice argued, however, that there is insufficient academic evidence of exposure or impact on which to base new regulations regarding digital HFSS food marketing to children and adolescents (12). Nevertheless, digital marketing, including for HFSS foods, is reported by brands and marketers themselves not only to be very successful but also to further amplify the effects of HFSS marketing in "traditional" media, enhancing advertisement (ad) attention and recall, brand awareness, attitudes and purchase intent and product sales (13–16).

The aim of this report is to summarize the evidence on children's exposure to HFSS food marketing in digital media and the persuasive power of that exposure. The term "child" is used to cover all children and adolescents under the age of 18 years, in line with the United Nations Convention on the Rights of the Child (2) and the WHO ECHO Commission report (3).¹ We also consider methodological challenges to research in this emerging field. We then outline existing regulation of HFSS marketing to children and consider the challenges of regulations to reduce children's exposure to digital HFSS marketing. As this is an emerging, transdisciplinary field, an expert review method was selected. Experts in HFSS marketing (its effects and regulation), public health, digital marketing, child rights, digital law and other relevant fields were consulted to obtain the most recent evidence available. Overall, the report focuses, when possible, on evidence from and regulatory action in the WHO European Region (much of the evidence to date has been generated in western Europe). Nevertheless, as findings on the effects of food marketing are similar throughout the world, the evidence, challenges and implications for policy development are likely to be applicable throughout the European Region and globally.

¹ "Convention on the Rights of the Child, Treaty Series, 1577:3 (1989): PART I, Article 1 defines a child as every human being below the age of eighteen years unless, under the law applicable to the child, majority is attained earlier. The World Health Organization (WHO) defines adolescents as those between 10 and 19 years of age. The majority of adolescents are, therefore, included in the age-based definition of "child", adopted by the Convention on the Rights of the Child, as a person under the age of 18 years."

Environmental factors that affect food choices, including food marketing

Individuals' eating habits, although frequently characterized as a matter of personal choice, are influenced to a large extent by food environments. In "obesogenic" (obesity-promoting) food environments, the combined actions of producers, retailers, food marketers and others ensure that HFSS foods are widely available (including in schools and leisure venues) and are often cheaper than healthier foods (17); in addition, HFSS foods are marketed to such an extent that, even in jurisdictions with statutory regulation, the overall "advertised diet" viewed by children in broadcast media is unhealthy (18–20). Empirical research in cognitive, behavioural and economic psychology has established that obesogenic environments interfere with individuals' ability to act in their long-term self-interest by choosing healthy foods and can contribute to the development of unhealthy preferences; therefore, regulatory action is not just desirable but is in fact required to protect individuals' ability to choose (21).

Yet, despite strong evidence of the effects of obesogenic food environments, progress in addressing them has been patchy, with limited implementation in many countries. Public and political discourse fails to support policy development by continuing to invoke individual choice and personal responsibility as the solutions to obesity (22). For example, parents state that it is their duty – not the government's – to protect their children by making good choices for them (23); some nutritionists focus on individual factors (see e.g. 24 and commentary in 25); and manufacturers and marketers assert that adolescents can "make good choices" for themselves (26) and that food companies are simply providing what consumers want (27). This line of argument characterizes policies designed to influence "choices" as paternalistic and likely to be ineffective, as "what the market produces is presumably what consumers demand" (28). With regard to regulation of food marketing to children, such discourse may explain the limited progress throughout the WHO European Region and worldwide and also delay in addressing the new challenge of digital marketing.

At the same time, however, there is growing consensus among international bodies that food marketing to children should be reduced, as seen in reports of the United Nations special rapporteur on the right of everyone to the enjoyment of the highest attainable standard of physical and mental health (29), the special rapporteur on the right to food (30), and opinions of the European Economic and Social Committee (31, 32). Furthermore, it is increasingly asserted that food companies and marketers have a social responsibility not to take advantage of consumers, particularly children and young people (21, 30). Most recently, the Vienna Declaration on Nutrition and Noncommunicable Diseases (33), the WHO European food and nutrition action plan 2015–2020 (34) and the WHO Commission on Ending Childhood Obesity (3) all reiterated that Member States should implement the Set of recommendations on the marketing of foods and non-alcoholic beverages to children (35) to reduce children's exposure to HFSS food promotion and its power.

The WHO set of recommendations on marketing of food to children (35) was based on an extensive, increasing body of evidence of the global prevalence of marketing² and advertising³ of HFSS foods and the impact of marketing on children's food preferences, purchase requests and consumption patterns (36–40). Much of the evidence and policy action to date refers to television food advertising, yet, in the digital age, food and beverage marketing has undergone a "paradigm shift" (41). Notably, the WHO recommendations call for comprehensive restrictions on *all* marketing of HFSS foods to children (32). Restrictions should therefore cover all media, including digital, to minimize regulatory loopholes and reduce the likelihood that restriction in one medium results simply in shifting marketing to other, less regulated media. Nevertheless, policies to restrict digital marketing, or "tech neutral" policies that apply to all media equally, have lagged behind developments in digital media marketing.

A rights-based approach to addressing the marketing to children of foods high in saturated fat, salt and/or free sugars

The transformation of the global communications and information landscape raises new challenges for balancing children's rights under the United Nations Convention on the Rights of the Child (2) to participation in social life (including on the Internet) but also protection from harms, including risk to health. Policy-makers envision digital participation as empowering children – as for example in the European Strategy for a Better Internet for Children (42). Scholars also convincingly argue that children are in fact exploited in digital networked environments, as digital platforms (e.g. search engines, social media,

² "an activity an organisation engages in to facilitate an exchange between itself and its customers" (1, p. 4)

³ "one type of marketing activity" (1, p. 4)

apps) extract personal information from users, viewing it “as a commodity to be exploited ... to gain competitive advantage” (43, p. 223). Such exploitation includes extensive marketing to children (44).

An overarching principle of the United Nations Convention on the Rights of the Child (2) is that, in actions concerning children, the best interests of the child are a primary consideration (Art. 3). The Convention articulates children’s rights to both participation and protection, and the digital environment is no exception. Children’s *participation* rights include freedom of expression (Art. 13), freedom of association (Art. 14) and access to information and the mass media (Art. 17). In addition to information and media access, Article 17 also encourages States to develop “appropriate guidelines for the protection of the child from information and material injurious to his or her well-being”. Furthermore, under the Convention, children enjoy *protection*, rights, such as rights to health (Art. 24), privacy (Art. 16) and protection from economic exploitation (Art. 32).⁴ The Convention on the Rights of the Child stipulates that these rights must be effectively protected (Art. 4), citing parental responsibility to nurture children (Art. 5), but importantly also invoking States’ responsibility to protect and assist families in doing so (Art. 18). Food marketing is also implicated in rights under non-child-specific instruments, such as the International Covenant on Economic, Social and Cultural Rights (8). For example, Article 12 provides for the right to “the enjoyment of the highest attainable standard of physical and mental health” and states specifically that nations should take the necessary steps for “the healthy development of the child” and “(t)he prevention, treatment and control of ... diseases”.

More recently, the human rights obligations of businesses (as distinct from States) have been articulated, with guiding principles and statements on how these apply to children (45–47). The United Nations Guiding principles on business and human rights (or ‘Ruggie principles’) (45), unanimously adopted by the United Nations Human Rights Council in June 2011, state that “Business enterprises should ... avoid infringing on the human rights of others and should address adverse human rights impacts with which they are involved” (p. 14). Business enterprises should consult meaningfully with stakeholders to determine the risks to human rights associated with their activities and take appropriate action to prevent and mitigate adverse impacts. The Children’s rights and business principles (47) identifies 10 general obligations, including ensuring that marketing and advertising “respect and support children’s rights” and to “(r)einforce government and community efforts to protect and fulfil children’s rights”. In the United Nations Global Compact’s list of Good practices per principle (48), the section on obligations in marketing and advertising includes many examples involving food and beverage manufacturers.

Taken as a whole, this rights-based framework suggests that children have a right to participate in digital media; that when they are participating, they also have the right to have their health and privacy protected and not to be economically exploited; and that not only should parents facilitate these safeguards but States should support parents in doing so. Therefore, the current challenge of restricting digital marketing of HFSS foods to children should be addressed through these inter-linked lenses: *reducing children’s risk* for health problems both now and in the future and *securing children’s right to be protected* from undue harm, while at the same time *facilitating their right to participate* in public life, including on the Internet.

We return to the central issue of balancing children’s participation and protection rights in media environments below when discussing implications for policy and legislative action. First, however, we outline the landscape of children’s use of digital media and the nature, extent and impact of digital marketing of HFSS foods, to underpin the case for expanding and strengthening food marketing restrictions in the digital era.

⁴ Handsley et al. (45, p. 131) argue that the reference in Article 32 to work does not exhaust the possibilities for economic exploitation and that “We are participating in the economy no less when we consume than when we work. Therefore, the exploitation of children as consumers answers the description of ‘economic exploitation’ no less than does their exploitation as workers. And advertising is central to the process of socializing children as consumers”.

Children and digital media

To understand the impact of HFSS food marketing in digital media, we outline the extent and nature of children's use of these media, the evidence for their engagement with marketing in digital media, and parents' awareness of their engagement.

Children's use of digital media in the WHO European Region

Children across Europe use digital media avidly and increasingly. In 2012, 15-year-olds in countries of the Organisation for Economic Co-operation and Development (OECD) reported using the Internet for nearly 2 h daily (109 min) on weekdays and an extra half an hour daily at weekends; use was lowest in Turkey and highest in the Nordic countries (49). Internet use is increasing sharply, with annual rises in all age groups in the United Kingdom (50); in a recent survey, 7–16-year-olds reported spending an average of 3 h online daily, while those aged 15–16 years reported nearly 5 h daily (51). The devices with which children access digital media have also changed rapidly. The Net Children Go Mobile study in six European countries (Belgium, Denmark, Ireland, Italy, Romania, Portugal and the United Kingdom) reported a “post-desktop media ecology” among children aged 9–16 years (52); smartphones were the devices most frequently used daily. Mobile device ownership is rapidly increasing: 67% of British children own a tablet (53), and tablet ownership is increasing very rapidly from a lower base in central and eastern Europe and Turkey (54).

In terms of Internet activity, multiple studies, including the EU Kids Online series, report that the Internet locations most visited by children are not child-specific but are platforms that provide access to a wide range of content for mixed ages, like Google, Facebook, Instagram and YouTube (52, 55). Younger children (9–11 years) in Europe go on the Internet mainly to view videos, such as on YouTube. Among older children, social networking dominates: over 50% of 13–16-year-olds have a social network profile, in steeply increasing numbers from 13 years (56). At 13–17 years, young people in the United Kingdom spend most of their Internet time on social media, accumulating 100 min daily (57). In some countries, underage children report substantial social media use according to the terms and conditions of media platforms, which typically set participation at 13 years; e.g. 78% of 10–13-year-olds in the United Kingdom reported having a social media account (49% Facebook; 41% Instagram) (58). In Denmark, adolescents reported being “always on” their smartphones, as social media such as Facebook are essential for social activity (organizing their non-digital lives; communicating with one another), and they consider them an integral part of their identity (59). The digital platforms, sites and channels used by children vary considerably by age and gender (60); by socio-demographic characteristics (61); by country (for example, in early 2015, the proportion of 16–19-year-olds reported to use Snapchat was 22% in Spain and 57% in Ireland (62); and over time.

Children's engagement with marketing in digital media

Although data on this topic are currently limited, some studies by researchers and digital media actors globally confirm that children engage with and enjoy digital marketing. In the United Kingdom, 73% of 1000 13–17-year-olds reported following brands they like in social media, 62% click on ads and 57% make in-app or in-game purchases (57). Nielsen data suggest that over half of adolescents in the USA “always” or “sometimes” look at mobile ads (63). A qualitative study of avoidance of ads by Australian adolescents on the MySpace social media site showed that, although they found some ads annoying and avoided clicking on them, they liked those that involved interaction or receiving something, such as playing games or receiving ring tones (64). In Egypt, young people aged 17–29 years reported following brand pages (including fast food brands) on Facebook and enjoying Facebook advertising, perceiving it as less intrusive than “pop-up” digital ads (65). They enjoyed “liking”, commenting on and “sharing” Facebook brand posts, generally for brands with which they were already familiar, and receiving shared content from friends, including for brands and products unfamiliar to them.

Parents' awareness of their children's exposure to digital marketing of foods high in saturated fat, salt and/or free sugars

A number of recent studies also explored parents' attitudes to Internet marketing to children. Parents' views are important, as their attitudes can create political will for change on such issues. Such views have been explored in Australia (66), Ireland (67), the United Kingdom (68–70) and the USA (71). The studies yielded similar findings. Parents were found to be largely unaware of the many HFSS marketing strategies used online. They assumed that it was not a concern and that their children

saw little HFSS advertising online and would ignore any they did see. The studies show that parents, who currently focus on the serious but rare Internet harm of “stranger danger” or online grooming, lack awareness of the much more widespread form of online risk and harm to which their children are likely to be exposed frequently. Once parents were shown examples of HFSS marketing that appealed to children and adolescents, however, they expressed alarm at the sophisticated, highly engaging techniques used, often considered this form of marketing to be exploitative and expressed a desire for it to be reduced. Parents’ lack of awareness of their children’s online HFSS marketing exposure raises the broader question of their ability to know about their children’s media activities and exposure, particularly on mobile devices. Conversely, digital platforms, marketers, food companies and other digital actors have extensive knowledge of children’s activities online – and it is to this issue that this report now turns.

Marketing in the new digital media landscape

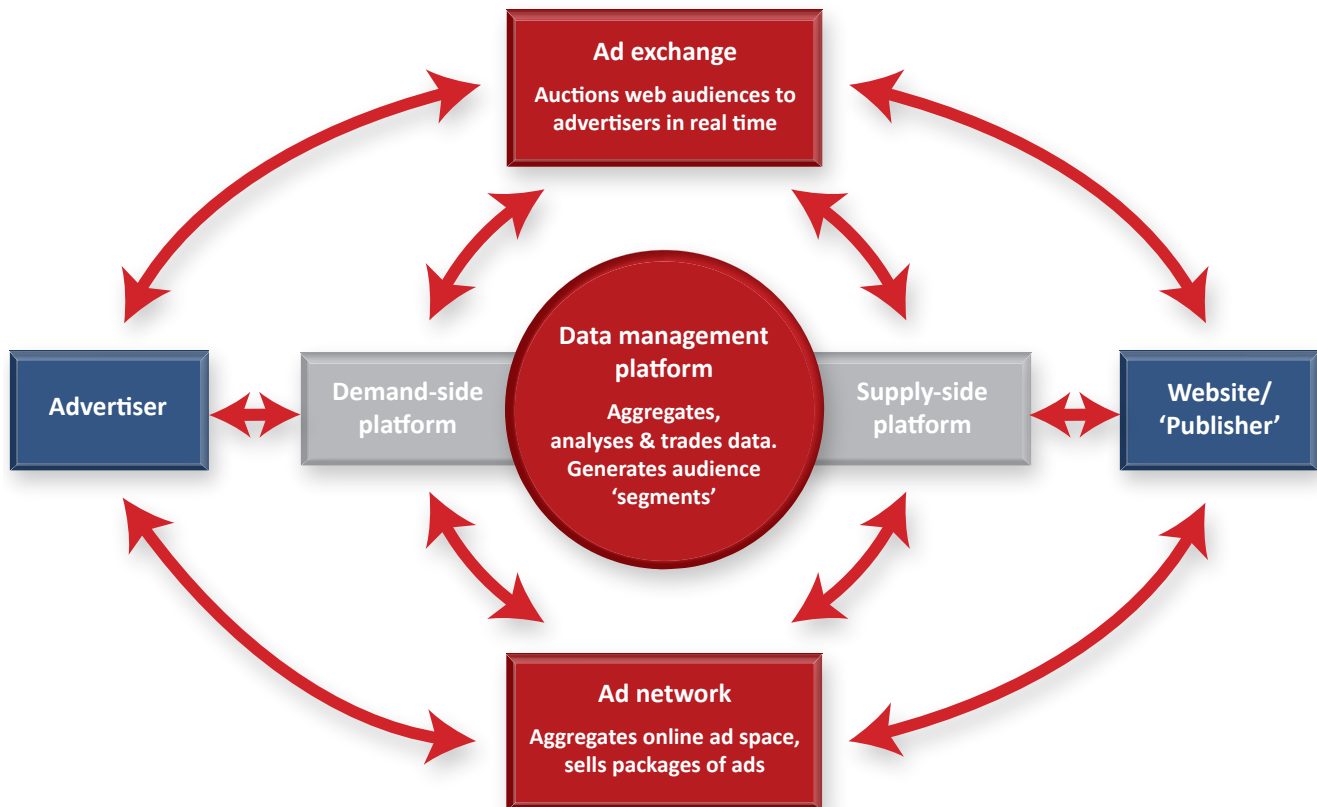
Digital technologies have revolutionized advertising and marketing (72). In this section, we first outline the nature of the new advertising ecosystem that facilitates marketing, define digital marketing and then describe the analytic and creative methods used by digital marketers.

Tracking and targeting Internet users online

In digital media, an extensive, highly complex system of advertising delivery has evolved, through which marketers can access much more specific audiences than in the broadcast era. A number of intermediaries facilitate the exchange of advertising and information between advertisers and websites and other digital platforms (referred to as “publishers”) (see Fig. 1). *Ad networks* aggregate the online ad space of websites and sell it in packaged format to advertisers. *Ad exchanges* are auction-based “real-time-bidding” services, to which websites make their defined audiences available: advertisers can bid for access to these specific audiences. To facilitate ad space sales and audience bidding, new platforms have emerged. Some manage available ad space on the seller’s side (i.e. the websites or “publishers”) and are known as *supply-side platforms*. On the ad buyer’s side (i.e. the advertiser), *demand-side platforms* provide the interface for buying ad space. The interaction of demand-side platforms, ad exchanges and supply-side platforms means that advertising space online can be bid for, valued and sold in milliseconds. As advertisers now buy access to media through many different platforms and intermediaries, *data management platforms* have evolved to interact with all the buying and selling platforms. These data management platforms aggregate, analyse and trade data on Internet users (audiences), store “cookie IDs” and generate ad audience segments for advertisers (73–76). Data management platforms “can help tie all that activity and resulting campaign and audience data together in one, centralized location and use it to help optimize future media buys and ad creative” (75). The entire system is predicated on the collection and analysis of ever-greater volumes of highly detailed user data. This “personal data tsunami” enables marketers to “target and market to specific people... foster(ing) a more catered, lasting relationship than ever before ... in ways previously unforeseen (that) will only advance as we go forward” (77, p. 136).

Advertising delivered to users on the Internet is tailored either to the *content* that a user is viewing on a site (*contextual advertising*) or to *characteristics and preferences* of each individual user (*online behavioural advertising*). To deliver contextual advertising, information on users is collected within the website, app or platform itself (78). To deliver online behavioural advertising, all participants in the advertising ecosystem collect and sell extensive information on users, drawn from dozens or more trackers on any one site or platform. Information on users is merged from multiple Internet locations and devices to create deep individual profiles that go far beyond basic demographics. User profiles include detailed data on online browsing activity, devices and networks used, geo-locations, personal preferences and “likes” and social activities in digital social networks (See box, Methods used to track users online and beyond) (76, 79–82). The use of tactics such as “zombie” cookies, device fingerprinting and geo-location allow digital platforms and brands to build extensive, detailed profiles of all who use the Internet, including children from 13 years of age. As a result, individuals’ “likes”, comments and other activities and preferences in social media have become a valuable commodity (83, 84). The extent of the application of these tracking methods is such that researchers have concluded that “advertisers are making it impossible to avoid online tracking” (85).

Fig. 1. Network map of advertising platforms in the online advertising ecosystem



Adapted by the authors from information in references 73–76

Brands that feature HFSS items are found to use such specific targeting and marketing approaches. One example is advertising for a top global Unilever ice-cream brand that used detailed analytics of Internet users' engagement with ice cream advertising online to tailor their ads for the weekly thought and purchase patterns of consumers. Use of this technique showed them that they should advertise differently in hot or rainy weather, and they planned shifts in advertising on the basis of weather forecasts. They were also able to prepare specifically targeted advertising in digital media from consumers' purchase history and flavour preferences (75). For fast-food brands, geo-location data from mobile devices enable marketers to deliver ads and special offers in real time when users are in the area in which they are sold, encouraging them to "walk in and buy" (86–88). Most recently, McDonald's in Japan partnered with the Pokémon Go game app (89), making the chain's restaurants important game locations; and local pizzerias in the USA have acquired Pokémon "lures" for as little as US\$ 10 to attract customers with an interest in the game (90). Such combinations of geo-location data, game apps and real-time targeting are particularly potent.

Tracking and targeting: a positive development or unethical activity?

Marketers present such uses of detailed, identifiable analytics as a positive development, as they allow consumers to receive more "relevant" advertising (91). Individuals' information is, however, extensively collected, sold and merged largely without users' awareness or explicit informed consent and almost always without feasible or evident opt-outs (79, 92). Indeed, as lengthy "privacy policies" are unclear to average consumers and are in fact rarely read, the practices are considered by many to be unethical (82, 91–94).

Methods used to track users online and beyond

Cookies: Small files placed on a user's computer system that track and record users' activities. Some cookies are used only for internal analytics or functionality (e.g. language preference, payment options), but many sites and platforms allow third parties such as advertising networks to place tracking cookies to collect information on users, to facilitate targeted marketing.

Flash cookies: These files are more durable and persist after a browser has been cleared, thus allowing tracking after users believe they have been deleted.

Zombie cookies: These files are even more durable than flash cookies, as they are re-created after a user has deleted them, allowing continued tracking.

Device fingerprinting: Users are tracked across the devices they use (e.g. smartphone, tablet, laptop) to integrate marketing appeals and offers. "Canvas"-based fingerprinting operates with no indication that a user's system is being fingerprinted.

Device graphs or social graphs: Individuals' (and families') linked devices are identified, or a user's personal digital connections are identified.

Geo-location: Users' exact location is mapped to deliver location-specific ads and promotions.

On-boarding: Combines online with offline data to generate even richer consumer profiles

Collated from references 76, 78–82

The Children's Online Privacy Protection Act (COPPA) in the USA (78) stipulates that personally identifiable information may not be collected from children under 13 years without verifiable parental consent and (since 2013) does not allow tracking across platforms with persistent identifiers, geo-location or behavioural advertising. COPPA applies to companies operating in the USA or collecting any data within the USA. As many companies internationally have applied this rule, it appears to have become the *de facto* international cut-off for online privacy protection. Its aim is to protect children and empower parents, and it is reported to have halted "some egregious predatory data practices" (95). Nevertheless, COPPA has substantial gaps, as it leaves children over the age of 13 years vulnerable. The FTC concedes that identifying and tracking children aged 13 years and over is a concern but continues to permit this. If children under 13 years lie about their age to access services for older children, which parents frequently assist them in doing (96, 97), or if parents give verifiable consent for their children's data to be processed and thus to allow them to receive behavioural advertising, marketers and digital platforms are permitted to treat children under 13 years online as adults (78). This is a substantial concern: as one of COPPA's original authors noted, the parental safeguard it provides is "increasingly ineffective", as the parents of younger children "cannot be expected to understand the sophisticated and often opaque operations employed in today's state-of-the-art digital marketplace, or the risks posed by them" (44, p. 780).

Furthermore, even when parents do not agree to the collection of personally identifiable information about their children, many sites and apps do so all the same. A survey of 1494 websites and apps "targeted at, or popular with children" across the world in 2015 by the Global Privacy Enforcement Network (98), conducted by 29 data protection authorities, found that many were not adhering to the COPPA regulations. Two thirds were collecting personal information without offering children or their parents adequate protective control to limit the use and disclosure of such information or a simple means of deleting an account permanently. For 40% of sites, the survey raised concern about the nature of the data being collected. Overall, therefore, COPPA appears to be largely ineffective: parents may agree to the collection of data on their young children, when giving them permission to play games or join certain sites, without realizing the implications; adolescents have no protection of any kind, and many sites and apps do not comply with COPPA in any case. Thus, children

of all ages currently receive little or no protection against the increasingly invasive personalized marketing practices of digital media.

Defining digital marketing

Marketing in digital media is characterized by powerful creative techniques and data analytics. Building on the early definition of Montgomery and Chester (99), we define digital marketing as:

Promotional activity, delivered through a digital medium, that seeks to maximize impact through creative and/or analytical methods, including:

- creative methods to activate implicit emotional persuasion, such as building engagement in social networks (e-Word-of-Mouth); using immersive narratives or social- entertainment- and humour-based approaches; using “influencers” popular with children, such as YouTube “vloggers” (video bloggers); using augmented reality, online games and virtual environments; or
- analysis of emotions, responses, preferences, behaviour and location to target specific groups, individuals and particular moments of vulnerability or to maximize the impact of creative methods.

Digital marketing techniques: creative engagement and immersion

In addition to extensive data analytics that allow profiling and targeting digital media users, including children, many “stealth” marketing techniques used in digital media take advantage of its creative, analytical and network capabilities. These include novel immersive techniques such as extensive HFSS-themed game applications (or “apps”); social media content created by users themselves; word-of-mouth social media communication, such as “liking”, sharing and commenting on marketing; and paid partnerships with vloggers popular with children.

In networked social media, word-of-mouth effects (“eWOM”) of marketing are crucial. As people are thought to trust friends’ recommendations more than those from brands or advertisers (100, 101), brands seek dissemination of their marketing in social media through friends’ networks. Brands also seek mentions from “influencers” or vloggers on platforms such as YouTube, as children view them as authentic, trusting their recommendations more than overt advertising by the brands (91, 102). Vloggers are even more effective brand advocates for adolescents than cinema celebrities: 63% of adolescents in the USA were happy to try a brand suggested by a YouTube vlogger or a blogger and only 46% one suggested by a film star (103). Agencies such as the Blogger Programme or BzzAgent seek to broker “authentic customer conversations across social media that drive product sales” (<https://www.thebloggerprogramme.com/>; <https://www.bzzagent.com/>). In the United Kingdom, the Advertising Standards Agency, in a ruling against widespread promotion of Oreo biscuits by vloggers on their personal channels (104, 105), warned them and marketers that commercial relations with companies that are not clearly signposted are a breach of advertising standards. Over a third of United Kingdom marketers, however, currently do not adhere to the standards because of lack of awareness or reluctance to be transparent (106); and, as the Advertising Standards Agency acts only on complaints made by viewers, its capacity to act on such activities is limited.

Digital marketing techniques: using analytics to optimize creative strategies and marketing “reach”

Marketers use digital analytics not only to optimize targeted ad reach, as described above, but also to maximize the effectiveness of creative marketing content. The data are used to understand individual consumer variation and “create new approaches for marketing researchers to segment their target markets” (107, p. 144). This involves use of neuroscience techniques, such as functional magnetic resonance imaging or facial emotion analysis (108). Although now described as “neuromarketing”, these methods are in fact largely an extension of the bio-neuro-sensory methods that have been used by marketers since the 1960s (109). The digital age facilitates the gathering and analysis of these data, for example, with in-device cameras to record facial responses to marketing content and software for immediate, millisecond-by-millisecond analysis, to better understand how to trigger consumers’ emotional responses, to identify “micro-emotions” and to specify by the millisecond how users respond to ad content (108).

Marketers are currently using and further developing emotion analysis methods to magnify the impact of digital marketing and to identify the most vulnerable moments (or “micro-moments”) of users (110). Individuals’ emotions can be identified through, for example, motion sensors in game consoles such as Xbox, sentiment analysis of social media comments,

keyword analysis of social media posts and even analysis of users' keystroke patterns (79, 111–113). Companies have used such methods to measure and inform marketers about the level and nature of attention that viewers give to an ad, combined with extensive demographic and activity data on users derived from their game-console activity (111). They have also used it to deliver “right-time targeting” in social media (112), i.e. ads that are applicable to users' thoughts or feelings at the moment, which has evident application for HFSS foods. Marketers are encouraged to position themselves and the products they are marketing as the “solution” to consumers' “pain” (114): for example, within video games, ad timing can be optimized for moments of heightened emotion, such as when a user experiences frustration at not reaching another level. As emotion-sensing chips in phones and wearable devices are predicted for the near future (115), the number of techniques for exploiting moment-by-moment emotions and vulnerability is likely to increase.

With analytics, marketing content and campaigns can be altered, even mid-campaign, in response to consumer reactions. With “ad placement optimization”, marketers can identify optimal locations and times to target Internet users, and digital analytics provide real-time ad campaign data, so that advertising content can be adjusted accordingly (116). Extensive, detailed analytics allow brands, marketers and social media platforms to identify the “reach” of ads and the extent of an individual user's attention that an ad is achieving (e.g. number of seconds viewed, extent of commenting and sharing). Facebook states that its analysis of hundreds of brand campaigns has linked ad attention to ad recall; therefore, Facebook and Instagram now sell ads on the basis of attention as well as reach (117).

Such techniques are widely used by brands and marketers to target young people, whom they consider a key demographic group (44). Taken together, the creative tactics and analytics described in this section equate to a brand appointing a personal marketer to each child, locating and identifying those who are most susceptible to their messages, encouraging them to send marketing messages to their friends, and following them throughout the day, at moments of happiness, frustration, hunger and intent, delivering advertising with the maximum impact, and directing them to the nearest place to buy foods to “fix” their current emotional state. The capacity to target marketing in digital media at the most susceptible young people is of particular concern, as children's receptivity to media effects varies according to their disposition, development and social factors, as accounted for in the model of differential susceptibility to media effects (118, 119). Individual variation accounts for the relatively small effect sizes often reported in media research, which are often used as a counter-argument to regulation. Effects are diminished when averaged across entire samples, but sub-groups that are particularly susceptible can be identified. This is a concern in view of evidence that HFSS marketing is targeted particularly at certain ethnic and socio-economic groups thought to be more vulnerable to such marketing and whose rates of overweight and obesity are significantly higher than those of other groups; these include African-American and Hispanic groups in the USA (120, 121). As digital marketers increasingly identify and target the children who are most susceptible to HFSS marketing, identify their locations and their emotional states and thus target them when they are at their most vulnerable, personalized digital marketing is likely to magnify the effects of broadcast advertising and could further magnify inequalities.

In this emerging, fast-developing area, we raise a note of caution. Neuromarketing, although considered promising, makes strong claims that may not be supported by the available evidence (122), and there is debate even among social media platforms and marketers about which metrics are the most meaningful (123). Yet, as the constant development and testing required to deliver digital marketing unfolds, platforms and marketers work continuously to maximize individually targeted, highly emotion-focused marketing, and they extract personal information wholesale to do so. This amounts to a vast, real-time, online experiment in human behaviour, one that is conducted within a “black box” system in which the decisions and data – unlike broadcast media – are not transparent to users or regulators (82). Scholars have called for the creation of ethics boards by all companies that manipulate user data, to ensure external oversight of platforms' algorithmic activities and “hold companies to account ... regardless of whether or not it is couched as research” (124). Although Facebook announced that it had created an ethics board in 2014 (125), the remit of the board and its lack of transparency fall short of the widely accepted ethical principles that govern research (126). We are unaware of any major digital platform, marketer or food company that is transparent about its in-house advertising research or that has addressed the ethics of targeted marketing to children – whether contextual or personalized.

Building on consideration of the novel techniques allowed by digital marketing's creative and analytical capabilities, the next section considers the food marketing that young people see when they use digital media and what we know about its impact on their eating behaviour and, therefore, diet-related health.

Behavioural advertising and implications for children's digital privacy

Marketing in digital media raises issues of digital privacy. Despite the existence of some regulatory protection, Internet users are tracked extensively, and their data are collected, stored, analysed, shared and sold for behavioural advertising to be delivered online. This activity is cloaked by "privacy policies" and terms and conditions on sites and social media platforms that are so long, legalistic and difficult to understand, even for experts, that they have been characterized as deceptive (92, 93). Companies view children as legitimate customers, and some have attempted to lower the age of Internet consent; e.g. Facebook proposed lowering the age of participation from 13 to 8 years, using an argument of "access to education" (127). Currently in the USA, schools facilitate extensive data collection from children and digital marketing through education partnerships (128).

Marketers and digital platforms claim that consumers readily give their personal information as a trade-off for benefits (94) and that more consumers are beginning to recognize "the value and self-benefit of allowing advertisers to use their data in the right way" (129). It is regularly claimed that privacy is an outmoded concept (130, 131) and that younger Internet users (so-called "digital natives") are most at ease with sharing information online. A recent study found that adolescents in the United Kingdom would sell their personal data for £15 (57). Indeed, in the United Kingdom, young adults seemed to accept giving and tracking of data more readily than older people (132).

In contrast to claims that customers are happy to share their personal data, Turow et al. (92) concluded that most Internet users allow commercial entities to take their data online out of resignation about their lack of personal control. Research on adolescents in Denmark, the United Kingdom and the USA (59, 133, 134) resulted in similar conclusions. Adolescents engage in careful online management of their online identity and social reputations but accept sharing to facilitate their social lives. In Denmark, adolescents believed that commercial "repurposing" of their data was a precondition for social participation in which they had no choice (59). In the United Kingdom, adolescents were generally more open than older participants to giving apps access to their photos, camera and geographical location; however, this was driven not by indifference to privacy but by their desire to communicate with their peers, in particular "checking in" at locations or posting photos on social networking apps (135). As social media have become the means by which adolescents have an engaged social life with their peers, the solutions to do not lie in imposing non-participation but rather in facilitating participation without targeting by marketers.

Targeted digital advertising is intrinsically linked to online privacy. Technological solutions that protect privacy while still delivering targeted advertising are being explored (see e.g. 136), although, given the financial rewards in the current advertising ecosystem, it is unlikely that the actors will desist from collecting extensive personal information from Internet users unless they are compelled to do so through strong regulatory action. Even if privacy-preserving advertising technologies prevail, however, concern would remain about targeting engaging and immersive HFSS marketing at children.

Children's exposure to digital marketing of foods high in saturated fat, salt and/or free sugars and its power

The WHO set of recommendations (35) notes that the effectiveness of food marketing depends on *exposure* (frequency and reach) and *power* (the nature, creative content, design and execution of the marketing message, e.g. use of persuasive techniques such as promotional characters). Currently, the evidence on digital media marketing in the public domain consists largely of analyses of the content of sites or pages created by food companies (food and beverage brand websites and social media brand pages) and occasional analyses of advertising on non-food websites popular with children. It therefore addresses the *nature* of digital food marketing (i.e. aspects of its power) and young people's *potential* rather than actual exposure.

Researchers examining food brand websites have found that child-oriented webpages frequently promote unhealthy products with dynamic, engaging, persuasive techniques. The British Heart Foundation (137) examined 100 websites for food and drink products likely to be bought or requested by children, including snacks and breakfast cereals; 80% included products that were not permitted to be advertised to children on television under United Kingdom broadcast regulations (138), which were marketed online with cartoons, animations, brand characters, competitions, games, downloadable content (e.g. mobile phone ringtones) and links to social networking site product or brand pages. In Germany, the nongovernmental organization "Foodwatch" (139) searched company and product websites and supermarkets in three German cities for items marketed to children by signatories of the voluntary EU Pledge, by which food companies agree not to market unhealthy foods to children (140). Of 22 Pledge signatories, 7 advertised unhealthy items on the Internet with child-directed content (65 of 281 items; 23%), such as games, comics, crafts and clubs; and of the 281 foods marketed to children, 90% (252) were identified as unhealthy by the WHO Regional Office for Europe nutrient profile model (141). In Ireland, the websites of the top food and drink retail brands (rather than child-directed brands or products) had little child-oriented content, but one in five had content that appealed to older children and adolescents, such as celebrity endorsement and competitions (20).

These studies usefully illustrate how food brands seek to engage children, but they may not indicate children's *actual* exposure to digital food marketing, as children are unlikely to spend much Internet time on food brand websites. A study in the USA of websites popular with children found that 60–84% of advertised products were HFSS foods or met the Institute of Medicine criteria for "foods to avoid" (142, 143).

Studies have also been conducted of food marketing *exposure and power* in social media. In Ireland, researchers (20) analysed *exposure* by identifying the Facebook "reach" of the 113 food brands most popular in retail sales and on Facebook among users aged 13 or 14 years. All 18 brands that Facebook estimated had the greatest "reach" in this age group featured sugar-sweetened carbonated drinks, fast foods, savoury snacks, sweets, chocolate and ice-cream. Content analyses of the *power* of these Facebook posts found they used the tactics of engagement, emotion and entertainment, with competitions, humour, links to entertainment events, bold graphics and links to eventful "special days"; the effectiveness of such approaches is underpinned by research on Facebook brand advertising that found humorous, brand "personality" advertising to be more effective than informative content (144). Most frequent – more so even than displaying the logo, packaging or the advertised item itself – were prompts to interact with ads: hashtags and invitations to like, comment and share, indicating brands' desire that adolescents would spread marketing through their networks (20). Similarly, an analysis of the most popular food and beverage Facebook brand pages in Australia included five that were most popular with adolescents aged 13–17 (again, featuring sugar-sweetened drinks, ice-creams, chocolate and fast food); it identified widespread marketing techniques, often unique to social media, that could increase consumer interaction and engagement and even facilitate direct product purchase (145).

Consistent with this, a study of the *extent* of Facebook HFSS marketing seen by children in the USA who engage with brands that produce HFSS items (henceforth, "HFSS brands") found that they were inundated with shared posts and

sponsored messages (i.e. paid advertisements): two hypothetical child profiles who had “liked” HFSS brands on Facebook received approximately 130 HFSS messages weekly over 2 weeks (146). Similarly, researchers in New Zealand documented 78 promotions weekly over 6 weeks for 20 “liked” food brands on Facebook (147). A recent exploratory study of user-generated content in Sweden (148) examined adolescent Instagram users’ food portrayals (identified with a youth-oriented hashtag): 85% of users shared images containing food items, most (68%) were unhealthy, and about half had clearly visible brand imagery. Notably, many images created by adolescents were clearly influenced by major food marketing campaigns.

Data on the *power* of digital food marketing are growing. The impact of exposure to Internet “advergaming” on children’s food choices and consumption has been studied. In a set of studies in the Netherlands, Folkvord et al. (149–151) demonstrated that playing food-based advergames increased children’s food intake, with an effect size similar to that of television commercials in equivalent research (152).

Impact of food marketing in digital media and children’s ability to counter it

The *impact* of digital marketing campaigns is likely to be substantial. Although there has been little external research on the impact of HFSS digital media marketing on children, social media platforms and marketers themselves report that social media marketing amplifies the effects of broadcast marketing, increasing target audience reach, ad memorability, brand linkage and likeability to a greater extent than television alone (153). In France and the USA, the direct return on investment for online Coca-Cola and Cadbury campaigns is reported to have been about four times greater than for television campaigns; e.g. in a Coca-Cola campaign in France, Facebook accounted for 2% of marketing cost but 27% of incremental sales (14). Facebook ads in 14 campaigns generated nearly triple the ad recall as compared with control groups (63), and econometric analysis of fast-moving consumer goods brand marketing (including food and drinks) in Europe found that combining online marketing with other media magnified returns on television (by 70%) and on cinema (by 71%) (14). A Nielsen Media report (age of participants not given) found that exposure to “homepage ads” on Facebook on a desktop or laptop computer (advertising that appears at the side of the main feed and typically includes an option for the user to engage with the brand, e.g. “become a fan”) increased ad recall, brand awareness and purchase intent – effects that were enhanced dramatically by adding social context (evidence that a friend had engaged with and was thus “endorsing” the brand) (63). This demonstrates the influence of Internet users on the perceptions and behaviour of others in their social network.

Children’s ability to resist marketing: the limits of the advertising literacy model

Analysis of digital food marketing methods and impact raises the issue of children’s ability to resist such marketing. Most HFSS advertising restrictions, including those of COPPA in the USA on digital data collection and behavioural marketing, apply only to children up to 12 years. This cut off is most likely based on dated, cognitive-focused developmental models of marketing persuasion that concluded that “advertising literacy” is achieved in early adolescence, when children can clearly recognize an ad, understand that advertising has a persuasive intent and can therefore protect themselves against its effects (154). Such models have several limitations, and we consider two. First, age-based restrictions on marketing in any medium are predicated on the implicit assumption that the age groups viewing marketing (whether in broadcast or digital media) are easily and clearly definable in advance (because they meet the intentions of the marketer for the “target” audience). In fact, this is not the case, and we return to this issue later. Secondly, age-based models of regulation in which older children are expected to activate cognitive defences against advertising do not account for the *emotional*, *implicit* (unconscious) and *social* effects of advertising. In order to counter the influence of food marketing, individuals must not only *understand* its persuasive intent but also require *conscious awareness* of it, and the *ability* as well as the *motivation* to resist (154, 155). The latter factors are, research demonstrates, often not present, undermining the notion of an age-based cognitive defence against advertising that is achieved with adolescence.

Cognitive models of advertising defence assume that viewers respond rationally to advertising information. Yet, *emotional* advertising was found to be most effective in a study of over 800 advertising campaigns (156), and emotions are processed differently from cognition, driving rapid decision-making (157). Modern psychological models predict that, even without conscious awareness, non-conscious (implicit) processing of advertising can influence beliefs and behaviour (154, 158), again challenging a cognitive-based ad defence model. In digital media, where marketing is often less recognizable, advertising may be processed implicitly even more often. On webpages, children could not consistently recognize simple static advertisements, even at 10–12 years of age (159), and identifying marketing is likely to be still more difficult in social media where the boundaries between marketing and other content are increasingly blurred. For example, in early 2015, Facebook adjusted its “News feed” algorithm to favour marketing posts that are less overtly promotional (160); the rise in the use of ad blockers means that less overt but still powerful forms of advertising are increasingly being used (161). Taken together, these findings indicate that advertising operates effectively through emotional, unconscious routes and that this may apply especially to digital media.

Of particular concern in this regard are adolescents, who have been largely excluded from discussions about food marketing and to whom HFSS brands argue it is ethical to advertise (see e.g. Mars marketing code; 26). Adolescents are developmentally, neurologically and socially likely to be susceptible to HFSS advertising (162): despite increasing cognitive ability, they may be more impulsive, because of neurological and hormonal changes, and they are typically more subject to peer influence, including regarding risky decision-making. In contrast to older adolescents and younger children, young adolescents aged 12–14 years are more likely to heed the behaviour of adolescent peers and less likely to follow adults regarding risky behaviour (163). In addition, adolescents typically have independent spending money and, in countries such as Cyprus, Ireland and the United Kingdom, have been found to use “fast” and “junk” foods as an identity marker to set them apart from adults (164–168).

Overall, therefore, suggestions that “advertising literacy” increases the resistance of older children to food advertising are not supported (154, 155). Policy and industry self-regulation – focused on protecting young children from television advertising that is consciously, cognitively processed – have been “eclipsed” by technological and commercial innovation in digital marketing (99, p. 5), by recent understanding of the effects of emotional and unconsciously processed advertising and by growing insight into the susceptibility of adolescents.

Research in digital food marketing to children: challenges and solutions

The foregoing depicts a global digital media landscape in which children and food marketers are active, parents have little awareness, and children receive little meaningful protection. Vast amounts of data on young people’s online activities and offline locations are collected, stored and analysed to deliver targeted, often personalized marketing. Detailed bio-neurosensory measures are combined with data analytics to identify advertising with peak impact and consumers’ moments of peak vulnerability, and ads are developed to engage powerful emotions in order to encourage young people to share them freely within their social networks. This scenario presents public health research and policy with challenges on a scale previously not encountered by those whose concern is the health and well-being of children. In this section, we outline the many research challenges facing the field, highlight areas in need of development and point to some potential solutions.

Challenges in exploring children’s engagement with digital marketing

There are many challenges in this new, fast-changing domain. Information on children’s exposure to and engagement with marketing in digital media is difficult to access. A literature review conducted on behalf of the United Kingdom Committee of Advertising Practice (12) called for more sophisticated research to establish *how many* children visit particular websites, for *how long* they engage with content, the extent to which adolescents are exposed to *location-based targeting* and

whether they *make use of these promotions*. Although such information exists, it is largely beyond the reach of academic researchers. Researchers have limited funding and hence restricted technical and analytical capacity; they are also hampered by the ability of platforms to change the nature of any existing access to data at will, reflecting an issue of wider concern regarding digital media: a substantial imbalance of power between digital platforms and other social actors. As Bucy and Zelenkauskaitė (169, p. 24) note, “Big Data – in contrast to broadcast material – is proprietary, collected covertly, is often user-generated, and requires system-level access and understanding. Access is limited to a select few, and is often restricted to the providers themselves. From a research perspective, what should be overt is kept covert”.

This represents a stark escalation of a long-standing imbalance, whereby the advertising and food industries are extraordinarily better resourced than public health and research bodies, not only for spending on food promotion (one estimate suggested that the amount that food companies spend on promoting unhealthy foods is about 500 times the amount that WHO spends on promoting healthier practices (170) but also in access to research and information. The imbalance is magnified not only by the power of digital analytics but also by the fact that digital platforms are private entities that consider information on users’ responses to marketing to be commercially privileged. Finally (and possibly partially because of difficulties with data access), the growing research literature on young people and digital media has, to date, almost completely ignored the issue of marketing (44).

Researchers wishing to understand children’s exposure to marketing in digital media now face substantial methodological challenges. With television advertising, it was possible for parents and interested adults to see what children saw. In the new media landscape, this is no longer the case, first, because children use devices with small screens that are not readily visible to others and, secondly, because of the new, personalized nature of marketing in digital media. Furthermore, gaining access to private social media accounts or children’s devices is unlikely to be sanctioned by institutional research ethics boards, as informed consent cannot be obtained from all members of a user’s network. Yet, such analyses are carried out at will by Facebook and others, as an integral part of their business model, without ethical oversight (124). Google, Facebook, Instagram and others and the food and beverage industries that advertise with them conduct analyses that provide extensive, sophisticated, extraordinarily fine-grained data that are not made available in the public domain. Even external access to rudimentary data is beyond the price range of most public health bodies; for example, we received quotes of over €50 000 to access limited competitive intelligence analytics and other analyses of marketing activities of brands featuring HFSS items in social media.

Almost all published social media analyses to date have focused on Twitter, as few tools are easily available to obtain data from other platforms, such as Tumblr, Instagram and Snapchat (171–173). Children in most countries, however, are less likely to use Twitter than other social media platforms (52). The terms and conditions of social media platforms typically restrict research by outsiders (174), and Facebook’s programming interface presents technical barriers to researchers (172, 175). In general, standard digital analytical tools cannot be used in social media without user authentication, even if users have given permission for their data to be accessed (e.g. raw data log files are accessible only to researchers employed by the social media company) or if a rare collaboration is established (176). Researchers report difficulty in obtaining responses from Facebook when seeking permission to conduct research (177), or conditions being imposed requiring that the research “improve the Facebook user experience” (176). Even when social media platforms are not configured to prevent access to certain kinds of data, the configuration can be changed without advance notice, and researchers have found that such changes in platform permissions or functionality have compromised their studies on Twitter (172, 178) and Facebook (179), even for studies for which they had already obtained informed consent from participants (176). Such risks may prohibit researchers from exploring these platforms.

Some researchers have attempted to advance understanding by studying the extent of food marketing in social media and on sites such as YouTube. Weak study design (no doubt in part due to the challenges discussed above) means, however, that studies to date are likely to have considerably underestimated exposure. For example, researchers have explored food marketing to children in social media but failed to account for the phenomena of contextualized or personalized marketing (180), or they have used self-reported recall of alcohol advertising online (181), which is particularly problematic in digital media, where advertising is less easy to identify.

Researchers who are not embedded in social media companies who wish to understand the activities of young people online are hindered by two further challenges. One is the technical challenge of isolating data from young people in large datasets from digital platforms, when these are available. The other is the ethical challenge associated with using young people's data, as accessing data, even if it is de-identified, for purposes that the individuals did not have in mind when they created them is raised regularly as an ethical concern in Internet research (173, 182–185).

The challenges outlined in this section reflect a broader social and ethical challenge that is currently receiving substantial media and academic attention. In general, on the Internet, there is a stark power imbalance between the digital platforms and other social actors. The algorithms used to deliver information and advertising online are powerful and exceptionally complex and do not allow for public scrutiny (113), and the major platforms and intermediary companies engage in extensive mining of social media data and metadata of all users, including children, with “tools and systems that... are typically opaque and are rarely open to public scrutiny and supervision” (131, p. 2). This challenge is most frequently discussed in the context of Internet privacy, but it also affects those seeking to examine the digital HFSS marketing to which children are exposed.

Some solutions: existing and novel methods for examining digital marketing

Some of the methods previously used to explore the extent, nature and impact of food marketing in other media may be appropriate for examining these factors in digital marketing. Kelly et al. (186) give examples of the use of cross-sectional surveys (e.g. 187), qualitative focus groups (e.g. 188), cross-sectional experiments (e.g. 189) and longitudinal studies and modelling studies (e.g. 190, 191). In addition, frameworks have been designed to quantify exposure to marketing and to guide monitoring, typically for policy evaluation: the WHO framework (192), a manual from the nongovernmental organization Consumers International (193) and an academic review (194). To explore digital food marketing, as noted earlier, content analysis may be applied (195, 196), and the study designs include brand website sweeps, as described by Henry and Story (197) and Brady et al. (198). Many of the frameworks and experimental paradigms, although not overtly medium-specific, lend themselves far better to studying television advertising rather than digital marketing. Furthermore, such approaches are limited in what they can uncover about *actual exposure* or the *extent of engagement* that children have with marketing across multiple integrated online dimensions, and many do not even begin to clarify how that engagement influences real-world health *behaviour*.

Some methods developed specifically for analysing digital media can be applied to HFSS studies. “Sentiment analysis” – the automated clustering of comments on social media and blogs and categorizing them as positive, negative or neutral – is well developed (see e.g. 199, 200). Image analysis is required for most food marketing research, which presents greater challenges for computational analysis (201), as the analytical tools that are currently easily accessible in social media are word-focused (171). As in all other instances, the major platforms are far ahead; for example, Facebook has developed sophisticated facial and other visual recognition capabilities (202). Highfield and Weaver (172) recommend, given the challenges currently inherent in visual analysis, a focus on metadata, harnessing hashtags rather than images or videos themselves, to understand “folksonomies” (folk taxonomies). One study captured children's exposure to environmental food marketing with small, unobtrusive, wearable, automated cameras, and explored use of automated digital analysis of the images collected; this may lead to further developments in the field (203, 204).

Research techniques that have been underused to date in food marketing studies may address unanswered questions in food marketing in the digital domain. Addiction studies have increased understanding of the association between exposure to salient alcohol cues and behavioural outcomes such as drinking, by measuring participants' eye movements with eye-tracking software to assess how a stimulus grabs and holds attention (attentional bias) (205). This has clear parallels with food marketing research, yet few studies have used this approach (41). Previous impediments to the use of eye-tracking in children (who must remain motionless for use of desk-mounted equipment with a fixed chin rest) no longer exist, as eye-tracking can now be built into laptops or webcams or even glasses for real-world measurement (<http://www.tobiiipro.com/product-listing/tobii-pro-x2-30/>; <http://www.eyetracking-glasses.com/>). Another technique yet to be fully explored is ecological momentary assessment: repeated sampling of behaviour and experiences in real time and in real-world environments. This overcomes the limitations of retrospective self-reporting (e.g. recall bias), maximizes ecological validity and can readily be operationalized at relatively low cost by use of basic smartphone or tablet technology (206). Future

research should incorporate such gold-standard techniques to explore responses to food and brand imagery and other salient food marketing cues.

We conclude this section with some cautions. In designing studies, researchers should remain alert to shifts in the social media landscape and practices among young people. Although one should remain sceptical of regular reports of the “death” of certain digital media platforms (e.g. in 2013, the death of use of Facebook by children was announced erroneously, due to misinterpretation of the findings of the Global Social Media Impact Study; 50, 207), it is advisable to avoid fixating on single platforms and, when possible, to develop non-platform-specific research questions or methods to ensure that the findings are generalizable. Currently, social media platforms for younger people, such as Snapchat, Tumblr and Instagram, are notably under-researched. Importantly, thoughtful researchers in this field caution against the excitement generated by apparent opportunities offered by Big Data; they particularly warn against its a-theoretical use and against assumptions that large samples necessarily yield representative, robust data (208, 209). To understand meaning and experience and to inform research design and hypotheses, qualitative research is required (172, 177), including the ethnography of young people’s social media activity and engagement with marketing (44). “Market-oriented netnography” – the application of ethnographic methods to examining marketing in digital media – has been proposed for some time (210) and could meaningfully be used to study HFSS brand activities aimed at children.

Digital marketing to children presents unprecedented challenges to researchers. More sophisticated research approaches are required, with extensive trans-disciplinary expertise, encompassing machine learning, mathematics, information technology, computational biology, psychology, children’s studies and more. Having examined the evidence for the extent and power of activities of HFSS food marketers in digital media and methodological challenges in this fast-developing research field, we now turn to consider the current state of regulation and how it may – and may not – protect children from HFSS marketing in the digital domain.

Existing regulation of marketing of foods high in saturated fat, salt and/or free sugars and its limitations

Existing regulations on digital marketing to children of HFSS foods have critical limitations. Some countries in the WHO European Region have explicit regulatory policies, but many limit their scope to broadcast advertising (211). Others rely instead on general marketing and advertising regulations, which do not specifically address the promotion of HFSS foods to children, or on self-regulatory codes of conduct, which are often designed and implemented by the food and advertising industries themselves.

Consumer protection acts or general marketing legislation: application to digital marketing to children

The countries of Europe have many combinations of regulations and non-regulatory codes relating to children and marketing, and it is often difficult to determine precisely what they all cover. In some countries, general marketing acts make reference to the protection of children. The Danish Marketing Practices Act (212), over which the Danish Consumer Ombudsman has jurisdiction, contains an explicit provision on marketing targeted at children: Section 8(1) requires businesses “to take special care not to exploit the natural credulity of children and young people, and their lack of experience and critical sense which makes them very susceptible to influence”. General marketing regulations are, however, rarely tailored to the specific issue of HFSS food marketing and tend to focus on ensuring that advertising is recognizable and does not mislead children or take advantage of their inherent vulnerability. Furthermore, the Danish law does not appear to have been applied to digital marketing of HFSS foods. Elsewhere, national legislation on media communications explicitly includes online media (e.g. Austria, Germany and Slovenia) and could be used to restrict digital HFSS marketing

(213). The extent to which such provisions have been used for the protection of children from digital marketing appears, however, to be limited.

In other countries, marketing legislation to protect children has focused on broadcast media. Sweden has a general prohibition on television advertising during programmes that appeal to children under the age of 12; five further Member States in the WHO European Region prohibit advertising in children's television programmes: four impose a partial ban or other restrictions on advertising in children's television programmes, either during specific time slots or for specific products; and seven prohibit the showing of sponsorship logos in children's programmes (213). These regulations are limited in their application, as they focus exclusively on children's programming (which does not reflect children's actual viewing patterns); they rarely address the use of persuasive techniques or the incitement to overconsumption and "pester power"; and they often fail to identify which foods are not permitted for marketing to children. Indeed, the reference in some regulations to "inappropriate" marketing may imply that some HFSS food marketing to children is appropriate. Furthermore, they fail to reflect the integrated reality of modern marketing communications and apply to one medium alone (typically broadcasting). In contrast, the European Union Audiovisual Media Services Directive (2010/13/EU) (214) has taken a broader approach and recommends national co- or self-regulation in HFSS food marketing to children that applies to traditional television as well as to newer services, such as video-on-demand, Internet television, streaming services and commercial live webcasts. Powerful digital marketing techniques such as online advergames are considered, however, to fall outside the scope of that Directive (215).

Such systemic incoherency means that existing rules, despite appearing to be "general principles", are scattered and are limited or not applicable to many current marketing communication channels and techniques (216). As a result, these policies often fail to adequately address non-traditional marketing (e.g. advergames) and platforms (e.g. social media), and there is convincing evidence that much marketing to children is readily permeating through the gaps in broadcast media regulation (18, 20, 217–219). Many countries with similar general marketing legislation (including provisions for marketing to children in general terms) have thus felt pressured to introduce additional codes of conduct specifically relating to HFSS food marketing to children. The Danish Forum for Responsible Food Marketing Communication (220) issued a code of conduct intended to limit the marketing of unhealthy food to children under the age of 13, with the support of the Danish Government.

Explicit policy and legislation on marketing of foods high in saturated fat, salt and/or free sugars

A few countries have introduced explicit policies or legislation to restrict HFSS food marketing to children; e.g. Ireland and the United Kingdom have statutory restrictions on broadcast advertising for HFSS foods in and around child-directed programming. While they tend to reduce marketing according to the criteria of the policy, these are typically quite narrow in scope, and monitoring of children's overall exposure reveals that they have not been as effective as initially hoped (18–20). First, they often have a limited definition of "marketing to children", e.g. marketing in *child-directed programmes* or marketing explicitly *targeting children*, where the regulation applies to programmes and advertising that have a high *proportion* of children in their audience but whose audience sizes, overall, are relatively small. Programmes viewed by the largest *numbers* of children (e.g. prime-time soap operas, reality shows, sporting events) are usually aimed at the general population, and the ads during such shows might attract children's attention but do not target them *specifically*. Therefore, such ads are not subject to restrictions. As a result, HFSS marketing moves to the non-restricted family viewing times, with larger numbers of child viewers than dedicated children's programming, and children's exposure may remain similar or even increase (221). Secondly, restrictions are limited to *broadcast* advertising, and marketers may shift their investment to other platforms. Sometimes, these shortcomings are cited as evidence that HFSS marketing restrictions are ineffective and therefore not a worthwhile policy option. A more convincing interpretation is that they have major loopholes (222), which, if addressed by expanded regulation, would substantially improve their efficacy.

Industry self-regulation of marketing of foods high in saturated fat, salt and/or free sugars

Self-regulatory approaches to restricting HFSS marketing to children have, to date, been the preferred choice of States and economic operators (223, 224). Most self-regulatory schemes apply primarily to television advertising and have only recently started to include digital marketing. The existing schemes are funded and administered by economic operators in

the food and marketing sectors, which have a vested interest in communicating to children, as do other commercial entities and media platforms. These schemes are largely part of companies' corporate social responsibility.

Evaluations of self-regulatory schemes indicate high compliance with the agreed criteria, and it could be argued that some action is better than none (225). Independent assessments by Galbraith-Emami and Lobstein (221) and others (226, 227), however, show that self-regulatory or voluntary schemes often have a narrow scope, weak criteria and limited government oversight. For example, use of narrow definitions of "child-directed advertising" in self-regulatory approaches, typically based on audience indexing⁵, has been criticized (228). Furthermore, focusing on the purported target audience of marketing material means that more qualitative targeting (e.g. the use of licensed and brand characters, child-directed messages and themes) is overlooked, despite evidence to demonstrate that children engage with and are affected by such components, even when they appear in adult-targeted promotions (229). Overall, Lobstein et al. (230) summarized the issue as follows: "In view of the substantial political power of the processed-food industry, government approaches to obesity prevention largely favour industry's preferences for a focus on individual responsibilities and soft approaches. These approaches, which are close to business-as-usual, are perpetuating the conditions that drive obesity."

Recent attempts to address digital marketing to children

Recognizing the shift in media use by children and responding to the challenge from the public health community, some governments and private sector actors have expanded the scope of policies or commitments to cover some forms of digital marketing. In Denmark, the Government-endorsed self-regulatory scheme now covers advertising on webpages targeting children, including those with games and chat rooms (20). In Norway, self-regulation goes further, to address *all* forms of marketing specifically aimed at children under 13, including social media (e.g. chat services, blogging tools and Internet communities), games and play sites and webpages that market products specifically aimed at children (231). In Spain, self-regulation covers marketing directed at children under 15 on the Internet, with rules on content, defining marketing to this age group by the type of product, design and attributes of the marketing communication, time and venue of dissemination and whether a website or section has an audience of more than 50% children under 15 (232); however, it does not prohibit any marketing, and no nutritional criteria are applied.

In the United Kingdom, where the statutory restrictions described above are in place for broadcast advertising, the Code of Non-broadcast Advertising, Direct Marketing and Sales Promotion (the Committee of Advertising Practice Code) (233) covers online media such as marketing communications appearing in social networking (or third party space) under their control. There is no nutrient profiling to distinguish between healthier and HFSS products (and restrict marketing of the latter) on non-broadcast media, but content restrictions apply to all marketing, such as promotional offers and the use of licensed characters and celebrities likely to appeal to children. A Committee of Advertising Practice consultation on proposals for further restrictions on advertising to children of food and soft drink products in non-broadcast media closed in July 2016 (234, 235), with outcomes expected to be announced in autumn 2016.

Similarly, in Ireland where statutory restrictions apply to broadcast advertising, the seventh edition of the code of the Advertising Standards Authority Ireland (236) covers all forms of marketing. It states that marketing communications for food to children should not encourage "unhealthy eating or drinking habits", but "unhealthy" is not defined, and no nutrient profiling is supplied, again implying that digital marketing of HFSS foods to children may be acceptable. The code prohibits marketing promotions and use of licensed characters (but not brand equity characters) for foods that are not permitted to be marketed to children under current broadcast regulations, if "targeted through their content directly at" children in pre- and primary schools (8.20, 8.22). The code requires marketers "not to create interest segments specifically designed for the purposes of targeting online behavioural advertising to children aged 12 and under" (18.3(c)), yet the impact of this rule is questionable, as it does not apply to mobile devices (18.2), and it does not apply to children aged 13 years and over.

In Portugal, new legislation approved at its first reading in Parliament (237) includes restrictions for HFSS food marketing on Internet sites or pages with content that is child- or youth-oriented.

⁵ Audience indexing is a tool that determines what proportion of a particular category of viewers (e.g. children) is watching a programme relative to the proportion of the audience as a whole.

The EU Pledge, a voluntary initiative by Europe's leading food and beverage companies to change the way they advertise to children, has expanded the original focus on advertising on television to include all company, brand and third-party websites, and – from December 2016 – product placement, interactive games, mobile and SMS marketing (225).

To date, there has been limited independent monitoring of these industry-led approaches to restricting digital food marketing to children. A new initiative from the governments of the Nordic countries to develop a joint monitoring protocol that covers digital marketing may go some way to addressing this challenge and will make an important contribution to our knowledge on this issue (238). As noted above, self-regulatory schemes generally report high compliance with their own agreed standards – yet these have a narrow scope and weak criteria. It is perhaps not surprising that the studies cited above indicate that these approaches have not been particularly effective in limiting digital marketing of HFSS foods to children.

Defining foods high in saturated fat, salt and/or free sugars across Europe and beyond: the WHO Regional Office for Europe nutrient profile model

The foods most frequently marketed to children are consistently shown to be “non-core” (or “eat less”) foods, such as sugary breakfast cereals, sugar-sweetened beverages, confectionery and savoury snack foods (239). Such HFSS foods are clear targets for restrictions; however, without explicitly defined nutritional criteria or thresholds, implementing restrictions becomes practicably impossible, a challenge that has been one of the biggest obstacles to policy development (240).

One tool for addressing this challenge is a nutrient profile model. Nutrient profiling is “the science of classifying or ranking foods according to their nutritional composition for reasons related to preventing disease and promoting health” (241). Of the 53 countries in the European Region, prior to 2015, only Denmark, Ireland, Norway, and the United Kingdom had developed or endorsed nutrient profile models for restricting HFSS food marketing to children (220, 242–244). A number of food companies and the EU Pledge (245) had also devised nutrient profile models.

Recent political mandates in Europe, notably the Vienna Declaration on Nutrition and Noncommunicable Diseases (33) and the European food and nutrition action plan 2015–2020 (34) reinforced a commitment to adopt strong measures to reduce all forms of marketing to children, raising calls for nutrient profile tools. In response, the WHO Regional Office for Europe prepared a nutrient profile model (141) to define those foods for which marketing to children is not permitted. The model specifies five food product categories for which marketing to children is never permitted: chocolate and sugar confectionery; cakes, sweets and biscuits; energy drinks; fruit juices; and edible ices. These are generally not recommended in national dietary guidelines, and other nutrient profile models restrict similar categories of product (including EU Pledge nutrition criteria). For other product categories, the nutrient profile model establishes thresholds per 100 g for fats (total and saturated), sugars (total and added), salt and energy (kcal). The content of these nutrients in products must fall below these thresholds if the products are to be permitted to be marketed.

Thus, there is now clear guidance on defining foods and non-alcoholic beverages that should not be marketed to children. Where statutory restrictions are implemented, they can clearly indicate that foods assessed as HFSS in accordance with a nutrient profile model may not be marketed to children (as in the current Irish and United Kingdom broadcast restrictions). The same would apply for digital HFSS marketing restrictions. The onus would be on the actor placing or disseminating the advertisement, promotion or sponsorship on the Internet to include nutritional criteria as part of overall compliance with marketing restrictions and on government authorities to monitor and enforce compliance.

Since its publication, the WHO Regional Office for Europe nutrient profile model has received substantial attention and is being applied in countries in the Region and incorporated into national policy. Three other WHO regional offices have pilot-tested the model and made only slight modifications. It therefore now has considerable potential for global application.

What should be done: rights and regulation

The effects of HFSS marketing on children in traditional broadcast media (e.g. television) have been demonstrated consistently. The targeted or personalized nature of digital marketing, with its capacity to identify the children who are the most vulnerable to marketing messages at their most vulnerable moments, makes it potentially a far more powerful influence on children's preferences and dietary behaviour. Evidence from digital platforms and marketers indicates that digital marketing is powerful and amplifies existing media effects. Action on digital marketing is therefore clearly required to fully implement the WHO set of recommendations (35), to reduce the exposure, power and impact of all HFSS marketing to children.

We have noted that current restrictions are narrowly defined, patchy and often take a platform-specific approach. HFSS marketing is found in unregulated media, undermining policy effectiveness. States require support to devise appropriate policies to restrict digital marketing, including guidance on the forms of marketing to be covered, the actors that should be restricted and enforcement mechanisms required. Here, we discuss factors that must be considered and addressed to tackle HFSS marketing to children in the digital domain.

Rights of children in the digital environment

Children hold many internationally recognized rights; importantly, these also apply online. The United Nations Human Rights Council consensus resolution on the promotion, protection and enjoyment of human rights on the Internet (246) asserts that “the same rights that people have offline must also be protected online”. At the beginning of this paper, we proposed a rights-based framework for the regulation of digital food marketing to children based on the rights to participation and protection accorded to children under the United Nations Convention on the Rights of the Child (2). This proposes that children have the right to participate in digital media; to have their health and privacy protected; not to be exploited economically; and that it is not only up to parents to facilitate this but is also incumbent on States to support parents in doing so.

Public policy with regard to children in the digital world has, however, focused almost exclusively on participation, in order to empower children (for example, with access to educational material); see, for example, the European Commission Strategy for a Better Internet for Children (247) and the paper of the Global Commission on Internet Governance on sustainable digital development for children (248). Regulation and protection have failed to keep up with the pace and scope of change in the media and marketing environments or have been delegated to the private sector or to parents, without the corresponding support from governments envisaged by Article 18 of the United Nations Convention on the Rights of the Child (2). Yet, the risk from HFSS marketing, as demonstrated by a large body of evidence, requires prompt regulation of digital marketing to children to uphold their rights and best interests as a vulnerable population group. The measures required include robust policy and statutory regulation independent of the food and advertising industries, strong regulatory oversight and enforcement, and meaningful sanctions for non-compliance.

Regulatory challenges

The many barriers to achieving a regulatory consensus on digital HFSS marketing to children include the borderless nature of the Internet; the global nature of digital marketing; and different concepts of “marketing”, what is targeted at children and indeed what is a child. Similar challenges have not prevented regulation in other areas, however. For example, despite global cross-border data flows and varying concepts of privacy and data protection, European Union States have taken collective action to protect individuals' personal data, most recently in the General Data Protection Regulation (GDPR) (253). Similarly, States, including the USA, have signed and ratified the Council of Europe Convention on Cybercrime (254), and great progress has been made in the health domain by States in committing to eliminate cross-border marketing of tobacco products within the European Union (255).

The challenges to be considered in regulating digital food marketing to children include age-based models and cross-border issues.

Privatization of human rights online: the “global default” fails to reflect the goals of the United Nations Convention on the Rights of the Child

The present era has been characterized as a digital “global default” era (249), as private actors, in accordance with their business models, establish online rights to expression and privacy. Formerly, governments set regulatory policies, but, in the digital environment, private Internet platforms set policies *de facto* (such as the *de facto* global free speech standards implied by content moderation on YouTube and Facebook). Internally, Internet platforms exercise decisions on what is permissible, and their criteria are largely unknown to the public. Therefore, the basic tools of accountability and governance – public and legal pressure – are very limited, as private actors hold the most power (250), resulting in the “privatization of human rights” (251).

Digital marketing and the extensive user tracking activities of social networking platforms are other areas in which children’s rights are left largely to the internal decision-making procedures of Internet platforms. As extensive resources are required for understanding and keeping up with changes in the digital environment, State actors and policy-makers are generally adopting a “wait-and-see” approach, although data protection agencies are beginning to take a stronger stance in some European countries; for example, the Belgian Data Protection commissioner has sought to halt Facebook’s tracking and data collection from users and non-users alike (252). Nevertheless, the current lack of regulation of HFSS marketing to children in the digital realm leaves them without protection, and they are treated as mere customers online, to be exploited by commercial interests.

The “wait-and see” approach does not reflect the precautionary principle or the goals of the United Nations Convention on the Rights of the Child (2). Those goals – treating children’s interests as a primary concern and balancing their rights to participation and protection – require something more proactive. Nor does the current approach reflect the required commitments outlined in the WHO Commission on Ending Childhood Obesity (3) to tackle obesity on a range of fronts.

“Children”: the challenge of age-based models for digital regulation

Achieving the goal of limiting children’s exposure to HFSS marketing requires agreement on who needs protection. In the sphere of digital privacy, this has been found to be challenging, as definitions of “childhood” differ between countries and regulations, and this challenge also applies to regulation of digital HFSS marketing.

As digital platforms do not allow individuals to opt out of the collection and processing of their data, participation is currently largely predicated on agreement by children or parents to terms and conditions of use, which entail giving permission for children’s personal data to be collected and processed. This in turn facilitates targeted marketing. As discussed earlier, in the digital realm – as for many existing broadcast and other schemes – adulthood begins at 13 years, according to the US Federal Trade Commission’s COPPA (78). As COPPA requires US digital platforms to comply with this cut-off even if they are processing non-US data, and non-US platforms to comply if they are processing US data (78), regulation-compliant content providers and social media platforms have largely followed suit worldwide. Within the European Union, only some Member States have legally established thresholds at which minors can validly consent to processing of their data (from 14 to 18 years) (256). Most, however, have not set explicit thresholds and rely on national data protection authority guidelines, which promote different standards and require evaluation of the capacity of the child and specific data collection circumstances (256). The European Union recently set a higher legal age limit, of 16 years, for consent to collection and processing of personal data in Article 8 of the GDPR, adopted in April 2016, which will replace the current Data Protection Directive 95/46/EC by 2018. Member States are permitted to set a lower age, but not below 13 years. These differences in the age of consent among European Union Member States and the difference between the new GDPR standard and the current COPPA rule are likely to add confusion and could lead to different standards of legal protection.

In practice, empirical evidence indicates that both Internet platforms (e.g. sites and apps) and users (children and parents) disregard these thresholds. COPPA age-based online privacy protection is not adhered to by many websites and apps directed at, or popular with, children, as evidenced by the Global Privacy Enforcement Network sweep (98) and most recently in fines levied on toy and media companies whose products were found to be tracking children online (257).

Furthermore, children under the age of 13 frequently give a false age in order to access social media services, and parents frequently assist them in doing so (96, 97). In the latter case, researchers caution that age-based privacy regulation may yield unintended results. When children under the participation age limit use platforms and apps, they are “treated as adults and presented the same information and privacy settings, without any consideration of their particular needs, online behaviour and risks of the online environment” (258), e.g. they are often exposed to HFSS marketing in various digital environments that are by definition not (officially, at least) “directed at” or “targeting” younger children.

This challenge mirrors those faced in specifying food advertising “targeted at” children on television versus food advertising to which children are “exposed”. In traditional media, marketing restrictions have often been limited to “children’s programming”, based on assumptions about older children’s media literacy in recognizing and resisting marketing, as discussed earlier. Such approaches, although certainly imperfect, have been workable and could easily be improved by applying them to programming that *appeals to or is popular with* large numbers of children, rather than to programming *targeted at* children.

In contrast, in much of the digital sphere, including on social media platforms, there is no guesswork about who is being reached by advertising, as digital platforms have in-depth knowledge about individual users from demographic and behavioural analysis. HFSS marketing restrictions could be applied to those children whom regulation stipulates should be protected. Interestingly, in the data privacy sphere, scholars have proposed a shift away from age-based regulation models to the development of *universal* privacy protections. This “would not only eliminate the problems with age-based prohibitions and circumventions, but also provide increased privacy protection to both adolescents and adults” (95). The rationale appears to be logical in the digital environment, where the complexity of online data collection and advertising practices and poor understanding of them even among adults mean that children are not the only ones who need protection (95). This approach has not, to our knowledge, been proposed yet for protection against digital marketing strategies that could harm health and has not been adopted by the forthcoming European Union GDPR. If universal privacy protections gain traction, it would be worth considering.

Cross-border jurisdictional challenges in regulating the digital environment

Another challenge for regulation is the Internet’s borderless nature and the potential for significant cross-border marketing communication. Regulation and standard-setting solely at national level are unlikely to suffice unless many countries take coordinated action. Importantly, the task of regulating a global phenomenon nationally or introducing universal standards in widely different national settings is not unique; similar challenges have been faced for instance in relation to data protection, such as the OECD Guidelines on the protection of privacy and transborder flows of personal data (258), the Council of Europe Data Protection Convention (259) and the European Union GDPR, and also to intellectual property (e.g. 260) and cyber-crime (261).

Pertinent examples from the health and media fields are the recommendations or provisions on marketing in the WHO Framework Convention on Tobacco Control (262), the European Union Tobacco Advertising Directive (263), the European Union Tobacco Products Directive (264) and the European Union Audiovisual Media Services Directive (214). Article 13 of the WHO Framework Convention on Tobacco Control calls for Parties to the Convention to recognize that “a comprehensive ban on advertising, promotion and sponsorship would reduce the consumption of tobacco products” and “to undertake a comprehensive ban of all tobacco advertising, promotion and sponsorship”, including “a comprehensive ban on cross-border advertising, promotion and sponsorship originating from its territory” (262). The European Union, which is a party to the Convention, subsequently introduced, via the above directives, a European Union-wide ban on all forms of advertising, audiovisual commercial communication (including product placement) and sponsorship for tobacco products that are of a cross-border nature (including via television, radio or Internet).

European Union competence is largely limited to marketing between Member States. For example, case law at the European Court of Justice has determined that, in view of the internal market, European Union regulations cannot apply to static marketing within a country (e.g. advertisements in hotels and airports, on billboards and shop awnings, umbrellas, ashtrays and similar items), advertisements screened in cinemas or sponsorship of events that have no cross-border appeal (257). European Union regulations could, however, apply to cross-border marketing (e.g. Internet advertising). On this

basis, and as a model, provisions in the Audiovisual Media Services directive relating to HFSS foods could be strengthened to restrict *cross-border* marketing to children of such products within the European Union, for example through regulation. Alemanno and Garde (257) effectively argued that, for services with significant cross-border implications (such as Internet advertising), supra-national (i.e. European Union) action is far more effective than action by individual Member States. For HFSS digital marketing at European Union level (214), however, co- and self-regulatory codes continue to be recommended, shifting the regulatory burden to Member States.

Ireland and the United Kingdom chose to go beyond European Union recommendations by introducing national legislation on broadcast HFSS food marketing. Nevertheless, according to European Union internal market rules on the free movement of goods and services, Member States can impose stricter standards only for marketing exclusively in their jurisdiction; they may not restrict re-transmission on their territory of media services from other Member States (265). For example, food advertisements broadcast in the United Kingdom but originating from outside must comply with the laws (or legal practice) in the country of origin rather than the statutory regulation of the United Kingdom. In this way, Member States are responsible for ensuring that audiovisual commercial communications by media service providers under their jurisdiction comply with relevant national legislation, but they cannot challenge another Member State in which media service providers are less regulated. This is clearly a concern in the continuing absence of European Union legislation, as much marketing content, particularly digital marketing, may originate from outside a country's jurisdiction.

Developments in privacy law may have parallels for marketing. The Belgian Court of Appeal recently ruled against the Belgian Data Protection Agency in its case against Facebook, concluding that only the Irish Data Protection Commission has jurisdiction over Facebook's European data processing activities, as Facebook's European headquarters are in Dublin. This countered the claim by the Belgian Data Protection Agency that, as Facebook has an incorporated entity in Belgium (Facebook Belgium), the Data Protection Authority has jurisdiction over its activities (253), although this is in line with the provisions of the forthcoming European Union GDPR (due to be implemented in 2018). In the context of continuing uncertainty, comprehensive national regulations targeting marketing originating domestically may have to be complemented by supra-national regulations on cross-border marketing in order to close all potential loopholes fully.

Some countries have attempted to close some of these loopholes through novel measures in other policy areas. For example, in the continuing absence of supra-national European Union legislation covering alcohol marketing, Finland has introduced innovative provisions in its Alcohol Act (266) to attempt to limit cross-border marketing targeted at all age groups in Finland. The Act covers both direct and indirect marketing and even textual or visual content produced by consumers or marketing that is intended to be shared by consumers. Under the Act, marketing accessible in Finland that originates from external operators is not subject to the regulation if it has the same content, irrespective of the country of destination; however, marketing originating from abroad is subject to the national restriction if the alcoholic beverages being promoted are placed on the market in Finland and are targeted at the Finnish market in particular. In this way, some cross-border marketing has been regulated.

Given the jurisdictional and regulatory challenges we have described above that are due to the Internet's borderless nature, further coordinated regulation is clearly needed across countries, and supra-national bodies (e.g. the European Union) have a role to play. As a first step, one way in which national regulation could contribute to reducing cross-border marketing would be to include provisions such as those in the WHO Framework Convention on Tobacco Control, whereby restrictions should apply to the placing of advertising, promotion and sponsorship on the Internet or other cross-border communications technology by any person or entity within the territory of a Party, whether the material targets persons outside or inside that Party's territory. Furthermore, restrictions should also apply to any person or entity that broadcasts advertising, promotion and sponsorship from within the territory of a Party that could be received in another State.

Requiring private Internet platforms to facilitate regulation: examples

Generally, the public sector delegates regulatory responsibility for digital marketing to private actors. For example, public sector regulation of human rights online in the digital sphere is very limited, and relies mainly on private sector "notice and takedown procedures" for enforcement of copyright infringement, libel or other content that is considered illegal (249). This provides for limited liability for Internet platforms, such as Facebook or Instagram, as long as they remove the allegedly

illegal content following notice received from authorities (see e.g. Article 14 of the Electronic Commerce Directive, 263). Some Internet intermediaries comply with such requirements to enforce copyright protection, protect individual privacy or remove hate speech and abusive material online (268). This suggests that one effective way of restricting digital marketing to children would be to require Internet content providers and platforms to regulate the distribution and accessibility of HFSS content online, similar to the mandate given to Google to become a *de facto* watchdog for individual privacy on the Internet (269).

Such a requirement is likely to be met with opposition from Internet platforms whose business model is based on extensive digital marketing. There are, however, successful examples in which Internet intermediaries were compelled to remove Internet content. Thus, if policy-makers and regulators made it a legal requirement for Internet platforms to remove digital marketing of HFSS accessible to children after e.g. receiving a notice from individuals or authorities, Internet platforms would be obliged to comply. To avoid issues arising regarding “behind closed doors” content moderation by Internet platforms, legal rules on removing digital marketing of HFSS items to children should explicitly include requirements for transparency and accountability.

Existing legislation and regulatory agencies

A number of overlapping national and international legal frameworks exist to regulate digital marketing. While these may provide options for regulating HFSS marketing to children, States might have to review them and consider any loopholes. Some regional policy frameworks (e.g. the European Union Audiovisual Media Services Directive and the European Union Data Protection Directive) partially address digital marketing and the need to protect children. These could be strengthened to include digital marketing of HFSS foods to children through regulation of cross-border marketing practices, but there is currently no internationally binding instrument. National digital marketing regulation can certainly play a role in addressing domestic marketing of digital HFSS foods to children; if more countries introduce measures, this would place pressure on cross-border marketing.

Currently, national regulation of digital marketing consists of a variety of national legislation, including the Danish Marketing Practices Act (270), the United Kingdom Data Protection Act (271) and the Australian Consumer Protection Act (272); regulatory agencies such as competition and consumer protection agencies; data protection commissioners; media and communications agencies; and industry self-regulatory initiatives. Examples are given below.

Consumer protection, data protection, privacy and spam legislation

- National consumer protection legislation (e.g. the United Kingdom Consumer Protection Act (273), the Danish Marketing Practices Act (266) and the Australian Consumer Law (267)) prohibits misleading or deceptive conduct, false or misleading claims and imposition of unfair contract terms.
- National data protection and privacy laws (e.g. the French *Loi informatique et libertés* (274) and the Dutch Telecommunication Act (275)) require businesses to be open and transparent regarding data handling.
- Spam is included in national data protection laws in the European Union, and many non-European Union countries have specific legislation on spam (e.g. Anti-spam legislation in Canada (276) and the Australian Spam Act (277)), which require businesses to obtain consent from a consumer before initiating a commercial electronic message and to ensure that the consumer can unsubscribe.

Although existing national consumer protection, spam legislation and data protection laws touch upon various aspects of digital marketing, their effectiveness – even when combined – is rather limited, as they lag behind the sophisticated data-driven techniques now frequently used by Internet content providers. For example, a Facebook user cannot “unsubscribe” from behavioural HFSS advertising, and users are not given alternatives (e.g. paid accounts without advertising), even though this requirement is spelt out under the data protection laws or so-called “spam legislation”. Existing legislation has broadly failed to address the lack of choice and meaningful individual consent and is therefore not equipped to address digital HFSS marketing. Further, in many countries, there are no explicit provisions relating to the restriction of digital marketing to children, even if the current scope of legislation implicitly covers such marketing.

Regulatory agencies for media and communications, competition and consumer protection and data protection

In addition to national and supra-national legislation and regulation, a number of national and federal regulatory agencies cover the various practices during the life cycle of content production and communication in digital advertising. Examples of regulatory agencies that might oversee digital marketing of HFSS to children and enforce compliance are:

- national media and communications agencies (e.g. United Kingdom Office of Communications (278), the Dutch Commissariat voor de Media (279) and the Australian Communications and Media Authority (280)) that have the power to impose penalties for violations of national communication legislation;
- national agencies for competition and consumer protection (e.g. United Kingdom Competitions and Markets Authority (281) and the US Federal Trade Commission (282)) that have the power to regulate the content of digital advertising through national consumer protection legislation; and
- data protection authorities and privacy commissioners (e.g. the French *Commission nationale Informatique et Libertés* (283) and the Office of the Australian Information Commissioner (280)) that have the power to impose fines on data controllers for data breaches or other violations of data protection legislation.

The regulatory enforcement power of these national agencies (including imposition of sanctions) is limited to their jurisdiction, and they do not have a mandate to impose sanctions or fines at the international level. These agencies can and do, however, cooperate at international level (e.g. the International Competition Network and the Global Privacy Enforcement Network) to share experiences and build capacity. Furthermore, there appears to be political will to extend their jurisdictional reach. For example, currently, businesses have to deal with many different data protection authorities in the European Union, but a “one-stop-shop” mechanism has been introduced under the new GDPR, in which one lead national regulatory data protection authority will supervise all the processing activities of particular businesses throughout the European Union (Articles 46–55 of the GDPR). In practice, this means that Internet platforms that process the personal data of European Union citizens would establish a relation with one national data protection authority (e.g. Facebook or Google with the Irish Data Protection Authority), which would oversee all its data processing activities throughout the European Union, not just in that particular Member State. This is a possible model for a supra-national mechanism for regulating HFSS digital marketing to children. There may be some uncertainty until 2018, given the ruling by the Belgian Court of Appeal in 2016 that Belgium does not have the authority to regulate Facebook because Facebook’s European base of operations is in Dublin, Ireland (253).

Key components of effective policies

As the digital environment continues to evolve rapidly, digital HFSS marketing to children deserves close scrutiny and demands prompt, remedial action by policy-makers. In the light of obligations under the United Nations Convention on the Rights of the Child (2) and the WHO set of recommendations (35), we make the following recommendations for acting on digital HFSS marketing to children online.

1. Acknowledge States’ duty to protect children online with statutory regulation

Regulation of HFSS marketing to children should be independent of HFSS food producers and of the advertising and media industries. Statutory regulation is a recognition of States’ duty to protect the rights of children online, including their right to health, as spelt out in the United Nations Convention on the Rights of the Child (2) and the United Nations Human Rights Council Consensus resolution on the promotion, protection and enjoyment of human rights on the Internet (246). Special protection for children online has been integrated into statutory regulation in COPPA (78) and the new European Union GDPR (253), among others, and we see no reason why digital marketing of HFSS could not be similarly addressed, thereby acknowledging States’ duty to protect children.

2. Extend offline protections online

The United Nations Human Rights Council pronouncement that “the same rights that individuals have offline, they must enjoy online” (246) suggests that the offline regulation of HFSS marketing to children should be extended to incorporate marketing in all digital environments. We recommend comprehensive regulation of all types of marketing in the digital environment, including social media platforms, websites, game platforms and apps, such as advergames. Regulations should be flexible to incorporate new and evolving digital marketing. Examples of “updates” to make frameworks fit for the digital world are found in the replacement of the European Union Data Protection Directive (285) by the new GDPR (246), the on-going revision of the Audiovisual Media Services Directive (209), the modernization of the Council of Europe Convention 108 and the OECD (258) guidelines on the protection of privacy and transborder flows of personal data.

3. Define legal age, rather than leaving commercial interests to do so

If an age-based model for regulating HFSS marketing is chosen as appropriate, a defined age should reflect recent evidence of the vulnerability of both adolescents and younger children, as outlined earlier in this report. We recommend that policy-makers act in coordination to proactively establish a clear minimum legal age for HFSS digital marketing to children and that this should be set at 16 years at least.

4. Define marketing directed to children

Challenges arise in defining “marketing to children”, as the Internet locations most visited by children are often not those “directed at” or “targeting” them but those providing access to a wide range of content (e.g. Google, Facebook, Instagram, YouTube). The most common current definitions restrict regulation to marketing “directed at” or “targeting” children. On the basis of experience in regulating digital privacy, and evidence that broadcast regulation restricted to “child-directed programming” has a limited impact, we recommend that regulation of digital HFSS marketing also address marketing for mixed audiences, to capture all the marketing that children are exposed to, including that on sites, platforms, apps and other digital locations likely to be of interest to children, even if children are not the primary target audience. The food and marketing industries may claim that industry should not be held accountable for the exposure of children to HFSS marketing “directed at adults”. Nevertheless, children’s exposure, even if it is an “unintended consequence”, has a negative effect on their health and must therefore be controlled carefully. The US FTC approach in COPPA could provide a model (despite its limitation of defining children as those under 13 years), as it usefully specifies that “if (a) service targets children as one of its audiences – even if children are not the primary audience – then (the) service is ‘directed to children’” (79). Provision should also be made for a mechanism by which media can be assessed externally as directed to children, rather than relying on claims by digital media and food brands themselves.

5. Draw on existing legislation, regulation and regulatory agencies

National governments could introduce marketing restrictions or bans on marketing HFSS foods to children under various existing legislation. Depending on the jurisdiction, health, child welfare, children and family, or food legislation (rather than digital marketing legislation) could be the most appropriate entry point. For example, Article 6f of the Healthy Lifestyles Bill in Malta includes explicit powers to enact specific subsidiary regulation to implement marketing restrictions for products (such as HFSS foods) that may have adverse effects on healthy lifestyles (286). Child welfare acts could be another entry point for legislation: the United Kingdom’s provisions on the protection of children from tobacco products contained in Part 5 of the Children and Families Act include recent measures on standardized packaging (287). As discussed earlier, the Alcohol Act in Finland comprehensively covers all forms of marketing. Alternatively, States could update existing marketing legislation with specific provisions relating to digital HFSS marketing to children to ensure that legislation is better equipped or streamlined for the digital era. A starting point at a national level would be to map the regulatory landscape so that the strengths and gaps of the existing legislation are better understood and the most appropriate national entry points for new or updated legislation are identified.

Regarding regulatory enforcement of restrictions on HFSS digital marketing to children, the model of the “one-stop shop” introduced for the European Union’s GDPR could be adopted. Furthermore, a network of national regulatory agencies such as those referred to earlier could be tasked to agree to the provisions of harmonized national legislation in the area of digital HFSS marketing, which might be effective in reducing its prevalence throughout the European Union. As stated

in earlier sections, strengthened, coordinated provisions on cross-border marketing for HFSS foods to children could be implemented at European Union level via Community legislation. For potential models, see Articles 9–11 of the Audiovisual Media Services Directive on tobacco (214) or Directive 2003/33/EC (263) on the approximation of the laws, regulations and administrative provisions of Member States relating to the advertising and sponsorship of tobacco products.

6. Compel private Internet platforms to remove marketing of foods high in saturated fat, salt and/or free sugars

To ensure effective enforcement and monitoring of digital HFSS marketing restrictions, regulatory agencies and policy-makers would in practice have to delegate parts of the task to Internet platforms, obligating them to remove digital marketing of HFSS accessible to children, after e.g. receiving a notice from an individual or authority. This has become the practice for Internet content regulation (in e.g. copyright enforcement, privacy rights or hate speech and abusive materials), because regulators themselves cannot directly access infrastructure to remove illegal content. To avoid lack of transparency in decision-making, policy-makers should take a proactive approach and articulate the transparency and accountability requirements of Internet intermediaries explicitly.

7. Develop appropriate sanction and penalty mechanisms

To support effective oversight and enforcement by regulatory agencies rather than private mediation by Internet content providers, meaningful sanctions should be introduced for non-compliance. The sanctions should apply to both the content creators (e.g. the HFSS and marketing industries) and the digital platforms that are content intermediaries (e.g. Facebook, YouTube, Instagram), which would face sanctions if they failed to remove the content after they had received a notice. Experience in regulating the digital environment in other areas, such as personal data protection, suggests that “naming-and-shaming” approaches often do not suffice, and high monetary penalties are required. The issues to be considered in imposing fines (such as the nature, gravity and duration of the infringement) must be clearly elaborated; e.g. the European Union GDPR (2016/679) establishes a tiered approach to penalties for breaches, enabling data protection authorities to impose fines of up to 4% of annual worldwide turnover for breaches of basic processing principles, such as conditions for consent, which is especially relevant to children. The size of the fines in the GDPR has attracted much attention from board-level executives preparing to implement the Regulation, suggesting that high monetary penalties for breaching HFSS marketing regulations would be an effective deterrent.

8. Devise cross-border international responses

Given the global nature of the Internet, effective international cooperation and responses will be fundamental to eliminating HFSS digital marketing to children. National initiatives and regulation might provide the impetus for regional and international efforts, coordinated by regional integration organizations and, ultimately, the United Nations. Calls have been made recently for the creation of a United Nations special rapporteur for children and young people’s sustainable digital development (248), who could, in cooperation with the United Nations Special Rapporteur on the Right of Everyone to the Enjoyment of the Highest Attainable Standard of Physical and Mental Health, and the Special Rapporteur (Right to Food), provide initial input and convene a platform for deliberations at the highest level. The WHO Framework Convention of Tobacco Control, with its clear requirements and guidelines (i.e. Article 13 on marketing), in addition to the convening power of the Conference of the Parties, provides a possible model for global coordination of HFSS marketing regulation to curb domestic marketing and prevent cross-border marketing emanating from within the territories of Parties to the Convention. In the absence of a global initiative, progressive action by Member States at national level should be supported.

Beyond regulation: recommendations for research and further action

- *Strengthen corporate social responsibility:* States have a duty to protect the human rights of children online and thus establish statutory regulation for digital marketing of HFSS to children. In addition, Internet content and intermediaries have a responsibility to respect the human rights of children online, as articulated in the United Nations Guiding principles on business and human rights. Defining providers' ethical responsibilities when children use their services (irrespective of whether they are of the requisite age) is crucial. This implies that companies reconstruct their corporate and social responsibility to pay more attention to the special needs of children (29, 30).
- *Address the ethics of conducting digital research with data from children:* Researchers should beware the "social media contradiction", in which Internet users typically think of their communications as ephemeral, whereas platforms such as Instagram and Facebook analyse, aggregate and use photos, videos, personal information and metadata commercially to facilitate targeted advertising (288). Researchers must be cautious in devising methods for research on social media and other digital platforms. "The question of public and public-ness, from an ethical perspective but also regarding how public and private are realised and performed on social media, is a critical element of social media research, especially around personal information revealed by users (whether deliberately or inadvertently)" (172).
- *Audit algorithms and supervise data mining practices:* Calls have been made for algorithm audits to calculate the effects of e.g. Facebook's News Feed selection process (113, 289) and for greater public supervision and regulation of data mining (131). Researchers concerned about personalized marketing to children should join these calls.
- *Disclose marketing spending, activities and reach and children's engagement:* The amount spent annually on marketing by leading HFSS companies should be publicly disclosed, including expenditure on social media, online video and mobile campaigns. These reports would be similar to Internet platform transparency reports, which cite, for example, how many complaints and requests they have received from regulators and users. They would bring HFSS industry in compliance with the United Nations Guiding principles on business and human rights. Trade associations such as the Internet Advertising Bureau in the United Kingdom (<https://www.iabuk.net/>) should be more transparent, in order to make such information available for informing policy.

Conclusion

In the new landscape of digital media, children should be supported and empowered to engage in the digital world to fulfil their rights to information and participation under the United Nations Convention on the Rights of the Child. Children's participation in digital media should not, however, be predicated on receiving digital HFSS advertising. Digital marketing can amplify the power of earlier marketing practices by identifying and targeting more vulnerable populations with sophisticated analytics and creating engaging, emotion-focused, entertaining ways to reach children. Nor should children's digital participation be predicated on "devolving" consent to parents, which is akin to States expecting parents to completely prohibit their children from watching all television in order to avoid HFSS marketing, rather than implementing broadcast regulations. Instead, States and supra-national actors should devise ways to allow children to participate in the digital world without being targeted by marketers with immersive, engaging, entertaining marketing of products that have been demonstrated to be injurious to their health.

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Uzbekistan

World Health Organization Regional Office for Europe

UN City, Marmorvej 51, DK-2100 Copenhagen Ø, Denmark

Tel.: +45 45 33 70 00

Fax: +45 45 33 70 01

Email: euwhocontact@who.int

Website: www.euro.who.int